

Gender and Technological Skill Acquisition in Engineering Education: A Statistical Examination

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Abstract: *This study seeks to help bridge the gap between industry and academia by examining the technological skills possessed by engineering students, the methods through which they acquire these skills, and the influence of gender on the acquisition process. A cross-classification analysis revealed that male students are more likely to seek information technology skills outside the university, resulting in an average of 3.06 skills per male student, compared to 2.2 skills per female student.*

Keywords—Skill Acquisition, Technological Competency, Gender Gap, STEM

1. INTRODUCTION

A frequently reported disconnect between academia and industry is often attributed to the production of graduates lacking the essential skills required by the workforce [1]. In developing countries, this gap further hinders technological progress [2]. Understanding the relationship between gender and education can help address these challenges, ensuring that students receive the necessary training and skill development to achieve optimal outcomes.

While several studies have explored the impact of gender on students' educational experiences, no research has specifically examined this influence within the context of engineering education in developing countries. For example, [3] established a connection between gender and the use of learning management systems, finding that female students exhibited a stronger correlation than their male counterparts. Similarly, a study focusing on predominantly Hispanic students identified gender as a contributing factor to academic success in college algebra, particularly in face-to-face learning environments [4].

Research has also been conducted to examine the relationship between gender and learning patterns [5]. Over a 10-year period, findings indicated that gender differences exist in lifelong learning, with a significant and positive correlation favoring women. Similarly, [6] identified a moderating effect of gender on the relationship between learning approaches and academic achievement at the university level. A related study, though focused on a single department, explored the impact of gender and age on academic performance within the Department of Vocational and Technical Education [7]. The researchers concluded that the relationship between these factors was non-linear, with the combined effect of gender and age being insignificant. This outcome was attributed to the presence of ICT and mathematics courses in the department, which may have influenced student performance—an observation supported by other researchers.

2. METHODOLOGY

In this study, a total of 112 students from 10 Nigerian universities were surveyed over a two-month period. The participants included undergraduate, postgraduate, and recently graduated students from the Faculty of Engineering at these institutions. Data collection and preliminary analysis were conducted using Google Forms [8]. The questionnaire was designed to be comprehensive yet easy to understand for the respondents.

Students were asked to select the technological and information technology skills they possessed from a predefined list of 24 skills. Additionally, they were required to indicate the extent to which these skills were acquired through university-related activities versus those obtained through external engagements outside the university.

After compiling the responses, a cross-classification analysis was conducted to determine whether there was a relationship between the skills acquired, the means through which they were obtained, and the gender of the students. To further analyze these relationships, a contingency table was created to provide deeper insights into the results of the cross-classification analysis.

3. DATA ANALYSIS AND RESULTS

A cross-classification analysis of the survey data is presented in Table 1. From the table, it is evident that regardless of the source of skill acquisition, male students tend to possess more technological skills than their female counterparts. On average, a male student is proficient in approximately 3.1 of the listed skills, whereas female students demonstrate proficiency in about 2.2 skills. This indicates that male students, on average, possess 0.9 more skills than their female peers.

Another key observation from the data is the source of skill acquisition. The findings suggest that the average student acquires around 1.8 skills through university-related activities. Specifically, male students gain an average of 1.9 skills from academic activities, while female students acquire 1.6 skills through the same means.

The data further supports the idea that extracurricular activities and engagements outside the university contribute more significantly to students' skill development. On average, 3.4 skills possessed by students originate from outside-the-

university activities. This trend is even more pronounced among male students, who acquire approximately 3.8 skills externally, compared to 2.5 skills for female students.

Table 1: Cross-Classification Table for Presented Data

	Total Skills from Inside Uni	Total Students with Skills from Inside Uni	Average Skill Per Student from Inside Uni		Total Skills from Outside Uni	Total Students with Skills from Outside Uni	Average Skill Per Student from Outside Uni	Total Skills for Male and Female Students	Total Number of Male & Female Students with Skills	Overall Average Skills Per Student	Total Skills from Inside and Outside Uni	Total Number of Students with Skills from In/Out Uni	Average Skills Per Student from In/Out Uni
Gender													
	(s11)	(n11)	(p11)		(s12)	(n12)	(p12)	(s1.)	(n1.)	(p1.)	(s..)	(n..)	(p..)
Male	75	40	1.88		249	66	3.77	324	106	3.06			
	(s21)	(n21)	(p21)		(s22)	(n22)	(p22)	(s2.)	(n2.)	(p2.)			
Female	23	14	1.64		59	24	2.46	82	38	2.16			
s.1	98			s.2	308								
n.1		54		n.2		90							
p.1			1.81	p.2			3.42						
Total Skills								406					
Total Students									144		406		
												144	2.82

Where: s11 and s12 is the number skills obtained by male students inside and outside the university respectively
s21 and s22 is the number skills obtained by male students inside and outside the university respectively
n11, n12, n21 and n22 represent the number of students with the said skills
s.1 = s11 + s21 is the total number of skills obtained from inside the university by male and female students
n.1 = n11 + n21 is the total number of male and female students with skills from inside the university
p.1 = s.1/n.1 is the average number of skills obtained by students from inside the university
s.2 = s12 + s22 is the total number of skills obtained from outside the university by male and female students
n.2 = n12 + n22 is the total number of male and female students with skills from outside the university
p.2 = s.2/n.2 is the average number of skills obtained by students from outside the university
s1. and s2. represent the total number of skills possessed by male and female students respectively
n1. and n2. respectively represent the total number of male and female students with the skills (s1. and s2.)
p1. and p2 = si./ni. respectively represent the average skills possessed by male and female students
s.. represents the total skills from inside and outside the university
n.. represents the total number of students with the skill in s..
p.. = s../n..

In order to further test this hypothesis, a contingency table from the data is designed. From this, a chi-square test of the sample data can be carried out which can help to establish a link between gender and acquired skills. The method of contingency table design is as illustrated in [9]. The result is shown in table 2.

The null hypothesis, H_0 , to be tested is that there is no relationship between gender and source of acquisition of skills

by students of engineering. The chi-square statistic is given as:

$$\chi^2 = \sum_{i=1}^2 \sum_{j=1}^2 \frac{(O_{ij} - E_{ij})^2}{E_{ij}} \quad (1)$$

Where O_{ij} is the observed value in the $(i,j)^{th}$ cell of Table 1 and E_{ij} is the corresponding expected frequency for $i = 1, 2; j = 1, 2$.

If the calculated χ^2 is $\geq \chi^2_{1-\alpha; (r-1)(c-1)}$ then the null hypothesis, H_0 shall be rejected. Where:
 r is the number of rows in the table and
 c is the number of columns in the table.
In this case $r = c = 2$

The null hypothesis can therefore be rejected if $\chi^2 \geq \chi^2_{1-\alpha; 1}$. Where α is the significance level which we have chosen to be 0.05 so that $\chi^2_{1-\alpha; 1} = \chi^2_{1-0.05; 1} = 3.841$

Table 2: Contingency Table for The Obtained Data.

i	j			Total
		No with Skills from Inside Uni	No with Skills from Outside Uni	
Males	Observed Value	40(n11)	66(n12)	106
	Expected Value	39.75(E11)	66.25(E12)	
	O – E	0.25	-0.25	
	(O – E) ²	0.0625	0.0625	
	(O – E) ² /E	0.0016	0.00094	
Females	Observed Value	14(n21)	24(n22)	
	Expected Value	14.25(E21)	23.75(E22)	
	O – E	-0.25	0.25	
	(O – E) ²	0.0625	0.0625	
	(O – E) ² /E	0.0044	0.0026	
Total		54	90	144

From (1) the chi-square value, χ^2 is then obtained as:
 $\therefore \chi^2 = 0.0016 + 0.00094 + 0.0044 + 0.0026 = 0.00954$

Which is not statistically significant at the 5% significance level ($\chi^2_{1-0.05; 1} = 3.841$) hence leading to the discarding of the null hypothesis, H_0 of independence between students and where they acquire their skills from. It can therefore be

concluded that there is a strong association or dependency between where the students acquire technological skills from and their gender.

4 CONCLUSION

This study has demonstrated that students are more inclined to seek skill development opportunities beyond what is provided by their universities to acquire critical competencies necessary for both academic success and future career prospects. This trend is particularly evident among male students, who acquire up to 1.52 times more skills than their female counterparts through external engagements.

Overall, male engineering students tend to possess a greater number of skills than female engineering students, regardless of the source of acquisition. This disparity may limit the career opportunities available to female graduates, as they may not meet industry skill requirements at the same level as their male peers.

The findings of this study highlight the need to bridge the gap between industry and academia, particularly in developing countries. Additionally, curriculum updates should be prioritized to ensure students acquire the essential skills demanded by the job market. Lastly, targeted efforts should be made to support female students in enhancing their skill acquisition, ensuring they have equal opportunities upon graduation.

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